

AD

Technical Note 10-84

HUMAN FACTORS EVALUATION OF THE MODIFIED AT-4 LIGHT ANTIARMOR WEAPON

Paul H. Ellis

August 1984

Approved for public release;
distribution is unlimited.

DTIC
ELECTE
NOV 13 1984
S E D

U. S. ARMY HUMAN ENGINEERING LABORATORY
Aberdeen Proving Ground, Maryland

Best Available Copy 84 11 08 011

AD-A147 482

ONE FILE COPY

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM										
1. REPORT NUMBER Technical Note 10-84	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER										
4. TITLE (and Subtitle) HUMAN FACTORS EVALUATION OF THE MODIFIED AT-4 LIGHT ANTIARMOR WEAPON		5. TYPE OF REPORT & PERIOD COVERED Final										
		6. PERFORMING ORG. REPORT NUMBER										
7. AUTHOR(s) Paul H. Ellis		8. CONTRACT OR GRANT NUMBER(s)										
9. PERFORMING ORGANIZATION NAME AND ADDRESS US ARMY HUMAN ENGINEERING LABORATORY Aberdeen Proving Ground, Maryland 21005-5001		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS										
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE August 1984										
		13. NUMBER OF PAGES 24										
14. MONITORING AGENCY NAME & ADDRESS (If different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified										
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE										
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution is unlimited.												
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)												
18. SUPPLEMENTARY NOTES												
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)												
<table border="0"> <tr> <td>Antiarmor Weapon</td> <td>Preparation to Fire Test</td> </tr> <tr> <td>Antitank Weapon</td> <td>Infantry Weapons</td> </tr> <tr> <td>Recoilless Rifle</td> <td>Infantry Weapons Portability</td> </tr> <tr> <td>Human Factors Evaluation</td> <td>Firing Instructions</td> </tr> <tr> <td>Soldier Mobility/Portability</td> <td></td> </tr> </table>			Antiarmor Weapon	Preparation to Fire Test	Antitank Weapon	Infantry Weapons	Recoilless Rifle	Infantry Weapons Portability	Human Factors Evaluation	Firing Instructions	Soldier Mobility/Portability	
Antiarmor Weapon	Preparation to Fire Test											
Antitank Weapon	Infantry Weapons											
Recoilless Rifle	Infantry Weapons Portability											
Human Factors Evaluation	Firing Instructions											
Soldier Mobility/Portability												
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)												
<p>The AT-4 is a man-portable, 84-mm antiarmor weapon designed by the FFV Company of Sweden who is represented in the United States by Honeywell Corporation.</p> <p>This AT-4 evaluation was conducted in two parts. The first part addressed its durability, ruggedness, and compatibility with the marine rifleman's fighting load. This took place on the USAHEL cross-country and</p>												

cont

→ mobility/portability course. The second part examined the time it took marines to prepare the weapon for firing, and the frequency and type of errors they made during the preparation.

Recommendations are made to improve the ruggedness, durability, and operational suitability of the AT-4.

The AT-4 was found to be a rugged weapon that is fast and easy to prepare for firing. It was enthusiastically endorsed by the marine test participants even though it is significantly larger and heavier than the lightweight antiarmor weapon (M72A1) with which they were familiar.

Original - supplied keywords include: Anti-tank weapons,
 Handless - M72
 and Infantry weapons.

★

HUMAN FACTORS EVALUATION OF THE MODIFIED AT-4 LIGHT ANTIARMOR WEAPON

Paul H. Ellis

August 1984

Accession For	
NTIS GRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

APPROVED:

John D. Weisz
JOHN D. WEISZ

Director

US Army Human Engineering Laboratory

Approved for public release;
distribution is unlimited.

US ARMY HUMAN ENGINEERING LABORATORY
Aberdeen Proving Ground, Maryland 21005-5001

CONTENTS

INTRODUCTION	3
OBJECTIVES	3
METHOD	3
PROCEDURES	5
RESULTS AND DISCUSSION	9
RECOMMENDATIONS	17
CONCLUSIONS	18
APPENDIX	
Operating and Aiming Instruction	19
FIGURES	
1. US Army Human Engineering Laboratory AT-4 "36-Round Test" - March 1984	11
TABLES	
1. Battledress Uniform and Personal Equipment	6
2. AT-4 Test Schedule	7
3. Preparation-to-Fire Data Time	16

HUMAN FACTORS EVALUATION OF THE MODIFIED AT-4 LIGHT ANTIARMOR WEAPON

INTRODUCTION

The United States Congress directed the US Army to evaluate all available light antiarmor systems as alternatives to the M72 LAW and VIPER. This evaluation was conducted in the spring of 1983 and included both domestic and foreign antiarmor weapons weighing 20 pounds or less. This comparison resulted in the selection of the AT-4 antiarmor weapon for further development, testing, and possible adoption by the Army .

As a result of the evaluation, the US Army Human Engineering Laboratory (USAHEL) and other agencies recommended various modifications be made to the AT-4. The external configuration of the original AT-4 was changed enough so that a second evaluation was needed to check the durability, ruggedness, and compatibility of the modified version's with the soldier's fighting load. US Army Missile Command tasked the USAHEL with conducting the evaluation on it's mobility and portability course. This evaluation was part of what has become known, within the participating agencies, as the "36-round test." Another test will follow which will be called the "1,000-round test."

OBJECTIVES

The objectives of the evaluation were as follows:

1. To assess the durability, ruggedness, and compatibility with the soldier's fighting load of the modified AT-4.
2. To evaluate the soldier's ability to prepare the modified AT-4 for firing.

METHOD

Test Participants

Ten US Marines (MOS 0311) were used as test participants (TPs). The TPs selected for this evaluation had no permanent or temporary physical profiles which would prevent their operating as light infantry, carrying loads up to 75 pounds. Anthropometric measurements

Hanlon, W. E., Brainerd, S. T., Bruno, R. S., Ellis, P. H., Hickey, C. A., & Woodward, A. A. Portability test and human factors evaluation of ten antiarmor systems. (HEL Draft Report). Aberdeen Proving Ground, MD: US Army Human Engineering Laboratory.

taken of the TPs yielded a mean height of 1738 mm with a standard deviation (S.D.) of 55.12 mm. The mean weight of the TPs was 77.59 kg with a S.D. of 8.48 kg. This compares with a mean height for the US Army population of 1745 mm with an S.D. of 66.1 mm and a mean weight of 72.23 kg and S.D. of 10.60 kg.

Test Facility

The USAHEI mobility and portability (M/P) course consists of a 3.79-km cross-country course and a 500-m obstacle course. It is the same course used in the first evaluation of light antiarmor weapons referred to on the first page.

Cross-Country Course

The first leg of the course is a cross-country trail; 2,180 m long. Along this trail are logs and fallen trees, a grassy field, dense foliage, a marshy area, thick grass and briars, and a muddy march to the stream. The second leg of the course is a 1,610-m road-march through a thickly wooded area extending to the obstacle course.

Obstacle Course.

The 500-m obstacle course consists of 20 obstacles in each of two lanes. Two lanes are provided so two TPs can run simultaneously. Thirteen of the obstacles are equipped with electronic pressure pads for recording the TP's start and finish times. These times are transmitted to a central control console, digitized, and recorded using a Hewlett Packard 9830 computer. The computer analyzes the time data so that the 13 obstacle times, 14 inter-obstacle times, and total course times are recorded for each TP.

Apparatus

Modified AT-4

This weapon is a one-shot, disposable, recoilless rifle issued as a round of ammunition. The weapon is 1 m long, weighs 6 kg, and has an outside diameter of about 105 mm. Its largest diameter (the rear venturi) is 150 mm; the inside diameter is 84 mm.

Uniform and Personal Equipment.

The TPs wore two different experimental battledress uniforms (BDUs) throughout the test. The BDUs were similar to the standard BDUs except that one was made of standard-weight fabric. The TPs wore the light-weight and the normal weight BDUs on alternate days. They also wore

²Churchill, E., & White, R.M. (1971). The body size of soldiers, US Army anthropometry - 1966 (Tech Rep 72-51-CE). Natick MA: US Army Natick Laboratory.

overshoes with an experimental liner insert for chemical biological protection. On days that were cold, windy, or rainy, they wore an experimental cold weather clothing system (ECWCS) parka. Table 1 lists the clothing and personal equipment used in this test. The BDUs, overshoes, and parka were being evaluated at the same time as the modified AT-4, but these evaluations were separate and did not interfere with that of the modified AT-4. Evaluations for the BDUs, overshoes, and parka will be discussed in a later report.

PROCEDURES

The evaluation was divided into two parts: durability, ruggedness, and compatibility, and of the preparation of the weapon to fire. The two parts were conducted concurrently, with the preparation-to-fire evaluation following each afternoon M/P course run.

Part 1: Evaluation of Durability, Ruggedness, and Compatibility

Training

On the first day the TPs were given a briefing on the nature of the evaluation and shown the modified AT-4. Its general characteristics and performance were explained. The TPs were then taken on a march through both the cross-country and the obstacle courses.

The next morning (see Table 2) the TPs marched through the cross-country course and ran the obstacle course with all their equipment except the LC-1 pack and the AT-4. That afternoon they marched through the cross-country course with their equipment plus the LC-1 pack which they shed before running the obstacle course. A third run through the obstacle course was conducted later in the afternoon. The TPs were instructed to complete the M/P course as fast as they could, keeping in mind that they would be expected to fire the AT-4 at an enemy tank when they finished.

The TPs were shown several methods of carrying the modified AT-4, and they were encouraged to try other methods to find the best for each circumstance.

Test Design

Each TP completed the M/P course twice on each of the 4 test days; once in the morning, once in the afternoon. The order in which each TP ran the course was varied randomly. Each TP carried the modified AT-4 eight times during the 4 test days.

TABLE 1

Battledress Uniform and Personnel Equipment

Item	Weight	
	kg	lbs
Underwear, cotton (medium)	0.2	0.4
Socks, wool (size 10-12)	0.1	0.1
^a BDU, jacket and trouser, standard-weight experimental medium-regular	1.7	3.8
^a BDU, jacket and trouser, lightweight experimental medium-regular	0.9	2.0
Belt, cotton duck, with buckle	0.2	0.4
Boots, black DMS (size 9)	1.7	3.7
Overshoe, vinyl, (size 9), with experimental CB liner	1.6	3.4
Helmet, M1 with liner and camouflage cover	1.5	3.3
Belt, individual equipment	0.4	0.9
Suspenders, individual equipment	0.3	0.6
Canteen, with cup, cover and 1 quart water	1.5	3.3
Canteen, with cover and 1 quart water	1.2	2.7
First aid kit, individual	0.5	1.2
Rifle, M16A1, rubber, training	3.0	6.6
Pouches, 2 each with weighted 30 round magazine	2.4	5.4
Grenades, 2 each, fragmentation	0.9	2.0
Grenade, smoke	0.7	1.5
TOTAL	18.8	41.3

^aWorn on alternate days throughout test.

Additional items were carried some of the time:

Pack, ALICE LC-1 (medium) with frame and weight foam block to simulate contents	14.3	31.5
Parka, ECWCS experimental (medium)	1.0	2.2

AT-4 Test Schedule

		DAY						
		1	2	3	4	5	6	7
MARCH	19 MON	20 TUES	21 WED	22 THURS	23 FRI	26 MON	27 TUES	
AM	TP In-processing, billeting, etc.	TPs shown obstacle course	AT-4 test run both courses with helmet, rifle, LBE AT-4	AT-4 test run both courses with helmet, rifle, LBE AT-4	AT-4 test run both courses with helmet, rifle, LBE AT-4	AT-4 test run both courses with helmet, rifle, LBE AT-4	Anthropometrics	
		Training run both courses with helmet, rifle, LBE	Preparation for firing training	Preparation for firing test	Additional obstacle course run without AT-4 with experimental BDU	Additional obstacle course run without AT-4 with experi- mental BDU	Obstacle course run without AT-4 with experiment- al BDU	
PM	TP introduction to test and administration	Training run both courses with helmet, rifle, LBE	AT-4 test run both courses with helmet, rifle, LBE, rucksack, AT-4	AT-4 test run both courses with helmet, rifle, LBE, rucksack, AT-4	AT-4 test run both courses with helmet, rifle, LBE, rucksack, AT-4	AT-4 test run both courses with helmet, rifle, LBE, rucksack, AT-4	Cross-country and obstacle course run with- out AT-4 with experimental BDU	
	Experimental BDU fitting							
	Familiarization cross-country course	Additional obstacle course run with helmet, rifle, LBE	Preparation for firing training	Preparation for firing test	Additional obstacle courses run without AT-4 with experimental BDU	Additional obstacle courses run without AT-4 with experimental BDU		

Cross-country course only
Note: LBE = load-bearing equipment

The 10 TPs were divided into two teams of five. Because only five launchers were available for the durability, ruggedness, and compatibility evaluation, one team would carry the launchers while the other team trained for preparing the weapon for firing. This schedule produced a total exposure for each of the five launchers of 16 cross-country and obstacle course runs. Each launcher was carried for 60.6 km of cross-country portage and 8 km of obstacle course. Throughout the testing, each TP wore one of the battledress uniforms and wore or carried all the other items listed in the top section of Table 1. The ALICE LC-1 pack was only carried for the afternoon cross-country march and not through the obstacle course.

Mobility and Portability (M/P) Course Procedures

The procedures were generally the same as those followed in earlier portability studies conducted on the HEL's M/P course (as described in TM 12-78 and TM 18-80).

Data Collection

Upon completion of each cross-country circuit, the launchers were examined for damage and photographs were taken. TPs were asked about any problems, comments, or pertinent information they might have had.

This procedure was repeated after each obstacle course run. The TPs, as a group, were informally debriefed early in the test and again after it was finished. The debriefing was videotaped. Motion pictures were taken periodically of the TPs negotiating the obstacle course and marching on the cross-country course. Total obstacle course times were recorded only to motivate the TPs. Any improvement in portability times of the modified AT-4 could not be measured because the original version was not available to use as a control.

Data Analysis

Because of the limited sample size of weapons (five) in this test, a rigorous analysis of the data were not appropriate. Component breakage, or lack of breakage, and TP comments can be compared to those from last summer's test.

Part II: Evaluation of Preparation to Fire

Training

Before taking part in this evaluation, each TP was trained in the correct method to prepare the AT-4 for firing. The training was conducted in a classroom in two groups of five TPs each by two representatives from the Swedish company FFV--the developer of the weapon.

The TPs were considered proficient at preparing the weapon for firing when they had performed two consecutive preparations correctly.

Testing Procedures

Following the afternoon M/P course run, each TP reported to the classroom and was tested.

The TPs started the test standing, with the launcher slung over their shoulder. On the command, "Go," they prepared the weapon for firing, aimed, and pressed the trigger. Timing began at the command and stopped at the snap of the firing mechanism.

Data Collection

Timing was done with a Heuer Microsplit electronic stopwatch. While standing, the TPs performed a practice trial at their own pace, followed by two trials for record. For a third trial for record, the TPs started from a standing position, fell prone, prepared the weapon, aimed, and fired. Any errors in procedures or other problems were noted. TP comments were recorded.

Data Analysis

Mean and standard deviation times for preparation to fire were calculated. No further analysis was undertaken.

RESULTS AND DISCUSSION

Part I: Evaluation of Durability, Ruggedness, and Compatibility

Results

Figure 1 shows breakages and malfunctions by distance and trial number, that occurred during the test. Sixteen runs were made through the cross-country and obstacle courses in an abusive test, amounting to 60.6 km of cross-country exposure and 8 km of obstacle course punishment.

We judged that all five of the weapons survived this ordeal in firing condition. None of the sights broke off even though the sight covers occasionally opened or fell off, leaving the sight upright and exposed.

Sand, dirt, and water got into the housing that holds the firing rod, but in most cases the weapon could still be cocked and the cocking lever swung to the fire position. In a few cases the lever had to be worked back and forth several times to loosen it up. Once cocked, the weapon appeared to fire normally. That is, the firing rod would move forcefully rearward. We could not determine if it would have enough energy to detonate a primer, but the project manager's office told us that if the weapon could be cocked, it probably would fire. If water or moist dirt got inside and froze, the weapon would probably be useless until it thawed.

CROSS-COUNTRY DISTANCE		7.6 KM	11.4 KM	15.2 KM	19.0 KM	
OBSTACLE COURSE DISTANCE		1000 M	1500 M	2000 M	2500 M	
LAUNCHER NUMBER	RUN	#1	#2	#3	#4	#5
	#1		● REAR SIGHT COVER ¼ INCH OPEN & JAMMED SEVERELY WITH SAND	■ SAND IN FIRING ROD HOUSING MADE ROD VERY STIFF UNTIL EXERCISED LOOSE ● ¼ INCH HOLE IN DIA PHRAGM	■ FRONT & REAR SIGHT COVERS JAMMED WITH SAND	● COCKING HANDLE FOLDED 90 DEGREE
	#2		● REAR SIGHT COVER ¼ INCH OPEN	■ SHOULDER STOP SNAP BROKE RIVET 10RN	● REAR SIGHT COVER ½ INCH OPEN	■ TAPE HOLDING FIRING ROD HOUSING ON TUBE WORN 25% AT HOUSING MAY BE ¼ INCH SIDE TO SIDE ● COCKING LEVER UNFOLDED 30 DEGREES
	#4	● REAR SIGHT FLIPS UP TO 30 DEGREE POSITION MUST BE PUSHED TO 90 DEGREES			■ SHOULDER STOP UNSNAPPED ● REAR SIGHT FLIPPED OPEN & APERTURE MOVED TO NIGHT MODE	● FRONT SIGHT COVER 1 INCH OPEN
	#5	■ SPLIT DIAPHRAGM ● SHOULDER STOP UNSNAPPED			■ DIRT IN FIRING ROD HOUSING DRAGS ROD	● COCKING LEVER UNFOLDED 45 DEGREES ● TRANSPORT SAFETY PULLED OUT
	#6	■ SHOULDER STOP UNSNAPPED	● COCKING HANDLE UNFOLDED 90 DEGREES	● REAR SIGHT COVER ¼ INCH OPEN	■ COCKING LEVER COCKED ● REAR SIGHT COVER ¼ INCH OPEN ■ SHOULDER STOP UNSNAPPED	■ COCKING LEVER UNFOLDED 90 DEGREES ● REAR SIGHT FLIPPED OPEN ● COCKING LEVER UNFOLDED 30 DEGREES ● ¼ INCH HOLE IN DIA PHRAGM
		■ CROSS-COUNTRY ● OBSTACLE COURSE				

9.0 KM 1500 M	22.8 KM 3000 M	26.6 KM 3500 M	30.4 KM 4000 M	34.2 KM 4500 M	38.0 KM 5000 M	41.8 KM 5500 M
#5	#6	#7	#8	#9	#10	#11
<ul style="list-style-type: none"> COCKING LEVER UNFOLDED 90 DEGREES 	<ul style="list-style-type: none"> COCKING LEVER UNFOLDED 45 DEGREES 	<ul style="list-style-type: none"> COCKING LEVER UNFOLDED 30 DEGREES TRANSPORT SAFETY PIN 3/4 OUT 	<ul style="list-style-type: none"> FRONT SIGHT COVER 1/2 INCH OPEN & JAMMED REAR SIGHT COVER 1/2 INCH OPEN & JAMMED TRANSPORT SAFETY LANYARD BROKE & PIN WAS LOST 	<ul style="list-style-type: none"> SHOULDER STOP UNSNAPPED 		
<ul style="list-style-type: none"> TAPE HOUSING NOT FIRING BOTH HOUSING UNTIL TUBE WOUND 2 1/2 ALLOWS HOUSING TO BE MOVED TOWARD SIGHT COVER COCKING LEVER UNFOLDED 90 DEGREES 			<ul style="list-style-type: none"> FRONT SIGHT COVER 1/2 INCH OPEN & JAMMED 1 INCH RADIAL TEAR IN DIAPHRAGM 	<ul style="list-style-type: none"> REAR SIGHT COVER 1/2 INCH OPEN 	<ul style="list-style-type: none"> COCKING LEVER UNFOLDED 90 DEGREES 	<ul style="list-style-type: none"> TEAR IN CREEP COCKING LEVER 90 DEGREES
<ul style="list-style-type: none"> FRONT SIGHT COVER 1/2 INCH OPEN 		<ul style="list-style-type: none"> REAR SIGHT COVER 1/2 INCH OPEN COCKING LEVER UNFOLDED 30 DEGREES 	<ul style="list-style-type: none"> REAR SIGHT COVER 1 1/2 INCH OPEN COCKING LEVER UNFOLDED 45 DEGREES 			<ul style="list-style-type: none"> TAPE HOUSING TUBE WOUND FIRING
<ul style="list-style-type: none"> FRONT SIGHT COVER 1/2 INCH OPEN SHOULDER STOP UNSNAPPED 	<ul style="list-style-type: none"> POINT IN FIRING ROD RELEASED ROD VERY STIFF UNTIL EXERCISED LOOSE 	<ul style="list-style-type: none"> REAR SIGHT COVER 1/2 INCH OPEN 	<ul style="list-style-type: none"> FRONT SIGHT COVER 1/2 INCH OPEN & JAMMED LOST REAR SIGHT COVER 	<ul style="list-style-type: none"> SHOULDER STOP UNSNAPPED REAR SIGHT COVER 1/2 INCH OPEN 	<ul style="list-style-type: none"> REAR SIGHT 1/2 INCH OPEN 	
<ul style="list-style-type: none"> FRONT SIGHT COVER 1/2 INCH OPEN SHOULDER STOP UNSNAPPED FRONT SIGHT COVER 1/2 INCH OPEN FRONT SIGHT COVER 1/2 INCH OPEN 		<ul style="list-style-type: none"> COCKING LEVER UNFOLDED 90 DEGREES 	<ul style="list-style-type: none"> COCKING LEVER UNFOLDED 90 DEGREES SHOULDER STOP UNSNAPPED DIAPHRAGM SPLIT ANOTHER 1/2 INCH 		<ul style="list-style-type: none"> REAR SIGHT FLIPPED OPEN 	

Figure 1. US Army Human Engineering Laboratory AT-4 "36-Round Test" - March 1984.

2

41.8 KM	45.6 KM	49.4 KM	53.2 KM	57.0 KM	60.8 KM
5500 M	6000 M	6500 M	7000 M		
#11	#12	#13	#14	#15	#16
			REAR SIGHT COVER 1/4 INCH OPEN		X*
UNFOLD	TEAR IN DIAPHRAGM INCREASE TO 2 INCHES COCKING LEVER UNFOLDED 90 DEGREES		TAPE HOLDING FIRING ROD HOUSING ONTO TUBE WORN THROUGH ON FIRE SIDE COCKING LEVER UNFOLDED 45 DEGREES		X*
	TAPE HOLDING FIRING ROD HOUSING ONTO TUBE WORN THROUGH ON FIRE SIDE		REAR SIGHT FLIPPED OPEN		
		REAR SIGHT COVER 1/4 INCH OPEN			X*
EC		COCKING LEVER UNFOLDED 90 DEGREES	LOST REAR SIGHT COVER COCKING LEVER UNFOLDED 90 DEGREES	LOST REAR SIGHT COVER	X*

* POST-TEST INSPECTION SHOWED THESE TUBES TO HAVE FRONT SEAL LEAK. EITHER THE DIAPHRAGM RUPTURED OR THE SEAL BETWEEN THE BUMPER AND THE TUBE BROKE.

If water, mud, or moist dirt got into the launch tube through a defective end cap seal and froze, we would expect the weapon to be not only useless, but dangerous if the shooter tried to fire it.

The sight covers on the modified AT-4 tended to slide partly open. Sometimes they would open only an eighth of an inch but other times they would fall off. Sand or dirt would often get into the tracks on which the covers slide, making the covers hard to open and close.

All of the weapons could have the rear sight stowed in either a 150-m or 200-m battlesight setting. The 50-m difference would probably result in an unacceptable degradation in hit probability.

The sight has two apertures: one for day use and the other for use in dim light. During the test, we noticed that the hinged flap containing the day aperture is not well secured in the proper position. While adjusting or stowing the sight, it is very easy to bump the flap either moving it higher, lower, or to one side. In many of these cases, the shooter could still look through the sight and did not know of any error. An off-center day aperture could reduce hit probability.

The rivet that holds the snap on the shoulder stop broke twice. Both times, a sharp portion of the snap remained where it could cut into the firer's shoulder, causing a potential safety hazard. However, the shoulder stop was good, and all of them were functional at the end of the testing.

The fiber-reinforced tape that binds the firing-rod housing to the tube, just behind the firing mechanism, wore through on two of the launchers and partly through on the other three. The damage was usually on the trigger side of the housing and always occurred where the sheet metal band went under the tape. It was caused by the rubbing of the launcher against the first aid kit or the canteen on the pistol belt. The damage allowed the firing mechanism and firing-rod housing to have up to a quarter of an inch of free play on either side. Whether the free play would affect the ability to fire the weapon could not be determined.

The transport safety pin pulled out on several occasions and the lanyard broke on another. The seriousness of these occurrences could not be determined.

Comparison With Original AT-4

Almost all of the problems with the AT-4 discovered in last summer's test have been satisfactorily corrected, but a few minor ones have surfaced.

The relocated attachment points of the shoulder sling virtually eliminated TP complaints about the poor balance of the original AT-4. The new attachment points and the soft bumper on the flared breech end of the tube solved the problem of the metal edge of the breech end being extremely uncomfortable against the carrier's leg. The TP's comments indicated that they believed the modified AT-4 was well balanced and not too heavy.

The carrying strap of the modified AT-4, while wider and of a softer and less slippery material, was rolled longitudinally so that it felt more like a rope than a strap. All of the TPs disliked the strap. They suggested that a pad be added to it "like the sling on the M60 machine gun."

The sling buckles on the earlier version of the launcher failed. The new ones went through the test without failure and held their adjustment.

The new folding cocking lever corrected the tendency to bend, break, and snag. Many of the new levers unfolded during the test but not one of them broke. One cocking lever became cocked accidentally while on the cross-country circuit, probably by snagging something in an unusual way. The redundant safeties (transport and fingertip) of the weapon would almost certainly have prevented the firing of the weapon.

A major failing of the original AT-4 design was the sights. The front and rear sights were not protected adequately and often broke. The sight covers on the modified AT-4 corrected this problem and none of the sights broke during the test. The basic design of the sights was also improved. The past design was a post and double peep (dual quadrant elevation), but the front post was a 45° white pyramid flanked by two 22-1/2° black wedges, all superimposed on a clear plastic blade. This unorthodox design was confusing to the TPs during the last test and most of them failed to hold the top surface horizontal. A 30° cant to the weapon was typical.

The present sight is a conventional post and adjustable peep that pops up preset for the battlesight range (fixed quadrant elevation) but allows the shooter to adjust for true range, if known. This sight was well liked by the TPs who agreed that it was easier to use than the M72 LAW, their only standard by which to judge light antiarmor weapon sights.

The front end cap on the original AT-4 would rupture or pull off. The new end cap also ruptured in all but one case. The end cap would not fall off, though, because it was bonded to the tube (along with the front bumper), but the bumper would sometimes snag on something and pull away from the tube enough so that the sealing was probably no longer watertight.

TP Comments

The following comments about the modified AT-4 were gathered during the evaluation and during the final debriefing:

- The carrying strap isn't wide enough and it rolls up. The strap should have a pad like on the M60 machine gun strap.
- A carrying handle would be very useful.
- The weight and length are O.K.

- The best way to carry it cross country is with the muzzle up and the carrying strap diagonally across the chest. If carried with the rucksack, the best way to carry it is horizontal under the rucksack flap.

- A good way to carry it through the obstacle course is to have it diagonally across the chest and strap tight across the back.

- The AT-4 is very easy to put into action and to aim.

- Would like to see a better pin for the transport safety. Maybe a tab or a cotter pin with a longer ring like that on a hand grenade.

- Decals should be harder to see (more subdued) so that a sniper couldn't find you by seeing the white on green labels. The red safety should also be changed for the same reason.

- The folding cocking lever is good.

- Overall good weapon. We expected it to fall apart at first but it held up well. Rate it an A-; the minus because the carrying strap rolls up.

- Good sights

- The shoulder stop often rubs on the back.

Part II: Evaluation of Preparation to Fire

Results

Table 3 contains the times recorded during the preparation-to-fire portion of the evaluation.

TABLE 3

Preparation-to-Fire Data Time
(secs)

TP#	<u>Standing</u>		<u>Prone</u>	Notes
	Trial#1	Trial#2	Trial#3	
1	11.4	8.0	16.3	Shoulder-stop snap broke on first trial
2	9.0	9.2	11.7	
3	10.6	7.6	8.0	Momentarily forgot to cock weapon on first trial
4	10.4	8.8	23.7	Didn't have shoulder stop against shoulder on third trial
5	9.6	9.1	21.4	Forgot to push safety on third trial
6	7.2	7.4	11.8	Rear sight cover fell off on third trial
7	11.6	8.8	26.8	
8	9.3	9.2	13.3	Pulled on safety instead of pushing it on first trial
9	8.3	7.2	16.0	
10	13.8	10.1	22.4	Rear sight cover came off on first trial; At first, had thumb on cocking lever instead of trigger on third trial.

Mean Time - Trials #1 and #2 - 9.3 seconds
 - Trial #3 - 17.1 seconds

Standard Deviation - Trials #1 and #2 - 3.0 seconds
 - Trial #3 - 4.1 seconds

DISCUSSION

The results show the modified AT-4 to be faster to prepare for firing than the fastest weapon tested in last year's light antiarmor evaluation which was the M72A1 (mean time of 13.0 seconds, standard deviation of 4.2 seconds). In that evaluation, the AT-4 had a mean time of 22.0 seconds and a standard deviation of 5.4 seconds. Because we did not have any original AT-4s to use as controls, we cannot determine whether the modified AT-4s improved time was the result of the modifications or of some procedural differences between the two evaluations (such as better training or more able TPs). However, since the modified AT-4 has no end caps to remove and the original version did, this may explain some of the time saved. The TPs commented that the AT-4 had better sights than the M72A1 because they were easier to use. They also felt that the AT-4 was easier to prepare to fire. The M72A1 was the only light antiarmor weapon with which these marines were familiar, which is why it was used as their standard of comparison to the AT-4.

RECOMMENDATIONS

We recommend the following changes to improve the operation of the AT-4:

- The front and rear sight covers should be made so they don't jar open as easily or jam with dirt. If they were made to be hinged and latched like the VIPER sight cover, they would be greatly improved.

- The rear sight and its housing must be redesigned so the sight can be stowed only at the correct battlesight setting.

- The day and night aperture mechanism must be made so it cannot be easily bumped out of the proper alignment.

- The front end cap should be redesigned so it does not rupture.

- The carrying strap must be more resistant to rolling up. Adding another layer of material to it would help.

- The way the fiber-reinforced tape holds the firing mechanism's housing onto the launcher should be redesigned so it does not wear through just behind the cocking mechanism.

- The decals, safety, and trigger button should be of a more subdued color. The white or red on each should be changed to light green, they would still be visible and distinctive against the dark green of the launcher, yet less likely to be seen by the enemy.

- The decals should be redesigned to describe more completely the way the weapon should be aimed and prepared to fire (See Appendix A).

- The rivet that holds the shoulder stop in the stowed position should be stronger.

- The transport safety ring should be larger (1-1/8 inches in diameter), or it should be a tab.

- A folding carrying handle should be attached to the weapon at the center of gravity on the right side of the firing-rod housing. This handle should then be evaluated for general usefulness and compatibility with the soldier's load-bearing equipment.

CONCLUSIONS

The AT-4 proved to be a rugged weapon capable of withstanding more than 60 km of cross-country portage and 8 km of obstacle course abuse.

The AT-4 was fast and easy to prepare to fire.

The Marine TPs, whose only experience with light antiarmor weapons was with the M72A1, liked the sights on the modified AT-4 better because they were easier to use.

The Marines did not feel that the weapon was too long, too heavy, or unbalanced. They felt that the AT-4's improved effectiveness made up for its greater size and weight compared to the M72A1.

APPENDIX A
OPERATING AND AIMING INSTRUCTIONS

Operating and Aiming Instructions

The operating and aiming instructions provided with the weapon, and a later version furnished by letter, do not thoroughly and clearly explain these procedures. The instructions should be comprehensive and clear, with steps keyed by sequence number to the controls on the launch tube. We recommend that the instructions be in light green lettering on a dark green background.

Included are recommended examples. Although these examples are white on black, they should be printed as light green on dark green.

FIRING INSTRUCTIONS

CHECK THAT THERE ARE NO FOREIGN OBJECTS
IN EITHER END OF THE LAUNCHER

- 1 PULL TRANSPORT SAFETY PIN
- FOLD OUT SHOULDER STOP
- RELEASE FRONT & REAR SIGHTS
- 2 COCK FIRING MECHANISM
- 3 AIM USE BATTLESIGHT SETTING UNLESS THE RANGE
IS KNOWN IF KNOWN ADJUST FOR TRUE RANGE
- 4 PUSH SAFETY TO THE LEFT AND HOLD DOWN
- 5 FIRE BY PUSHING THUMB TRIGGER FORWARD

5



TRIGGER
PRESS FORWARD
WITH THUMB

COCKED

4



SAFETY
PUSH TO LEFT
& HOLD DOWN

1 TRANSPORT
SAFETY
PIN
PULL TO ARM

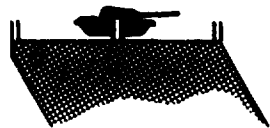


DANGER AREA

2 SAFE

3 AIM

→ DIRECTION OF TARGET MOVEMENT →



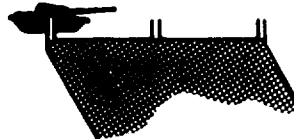
VERY SLOW
OR STOPPED
0-5 MPH

CENTER POST -
CENTER OF MASS



MEDIUM SPEED
5-10 MPH

CENTER POST -
FRONT EDGE OF TARGET



FAST
OVER 10 MPH

LEFT POST -
CENTER OF MASS
OR RIGHT POST -
CENTER OF MASS FOR
A TANK MOVING RIGHT TO LEFT